

## PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY  
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference <b>E40370 JFL/J</b>	<b>FOR FURTHER ACTION</b> See Form PCT/IPEA/416	
International application No. <b>PCT/NO2005/000093</b>	International filing date (day/month/year) <b>18-03-2005</b>	Priority date (day/month/year) <b>24-03-2004</b>
International Patent Classification (IPC) or national classification and IPC <b>See Supplemental Box</b>		
Applicant <b>QuickFlange AS et al</b>		

<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of <u>5</u> sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> (<i>sent to the applicant and to the International Bureau</i>) a total of <u>20</u> sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (<i>sent to the International Bureau only</i>) a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>																									
<p>4. This report contains indications relating to the following items:</p> <table> <tr> <td><input checked="" type="checkbox"/></td> <td>Box No. I</td> <td>Basis of the report</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. II</td> <td>Priority</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. III</td> <td>Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. IV</td> <td>Lack of unity of invention</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td>Box No. V</td> <td>Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. VI</td> <td>Certain documents cited</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. VII</td> <td>Certain defects in the international application</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. VIII</td> <td>Certain observations on the international application</td> </tr> </table>		<input checked="" type="checkbox"/>	Box No. I	Basis of the report	<input type="checkbox"/>	Box No. II	Priority	<input type="checkbox"/>	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability	<input type="checkbox"/>	Box No. IV	Lack of unity of invention	<input checked="" type="checkbox"/>	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement	<input type="checkbox"/>	Box No. VI	Certain documents cited	<input type="checkbox"/>	Box No. VII	Certain defects in the international application	<input type="checkbox"/>	Box No. VIII	Certain observations on the international application
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<input type="checkbox"/>	Box No. VIII	Certain observations on the international application																							

Date of submission of the demand <b>10-10-2005</b>	Date of completion of this report <b>07-03-2006</b>
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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.  
PCT/NO2005/000093

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Cover sheet

**International patent classification (IPC)**

**B21D 39/06** (2006.01)

**F16L 19/02** (2006.01)

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.  
PCT/NO2005/000093

## Box No. I Basis of the report

1. With regard to the **language**, this report is based on:

the international application in the language in which it was filed  
 a translation of the international application into \_\_\_\_\_, which is the language of a translation furnished for the purposes of:  
 international search (Rules 12.3(a) and 23.1(b))  
 publication of the international application (Rule 12.4(a))  
 international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

the international application as originally filed/furnished  
 the description:  
 pages \_\_\_\_\_ as originally filed/furnished  
 pages\* 1 - 7 received by this Authority on 10-10-2005  
 pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_  
 the claims:  
 pages \_\_\_\_\_ as originally filed/furnished  
 pages\* \_\_\_\_\_ as amended (together with any statement) under Article 19  
 pages\* 8 - 10 received by this Authority on 10-10-2005  
 pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_  
 the drawings:  
 pages \_\_\_\_\_ as originally filed/furnished  
 pages\* 1 - 10 received by this Authority on 10-10-2005  
 pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_  
 a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3.  The amendments have resulted in the cancellation of:

the description, pages \_\_\_\_\_  
 the claims, Nos. \_\_\_\_\_  
 the drawings, sheets/figs \_\_\_\_\_  
 the sequence listing (*specify*): \_\_\_\_\_  
 any table(s) related to the sequence listing (*specify*): \_\_\_\_\_

4.  This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

the description, pages \_\_\_\_\_  
 the claims, Nos. \_\_\_\_\_  
 the drawings, sheets/figs \_\_\_\_\_  
 the sequence listing (*specify*): \_\_\_\_\_  
 any table(s) related to the sequence listing (*specify*): \_\_\_\_\_

\* If item 4 applies, some or all of those sheets may be marked "superseded."

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No. PCT/NO2005/000093
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Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
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## 1. Statement

Novelty (N)	Claims	<u>1-6</u>	YES
	Claims	_____	NO
Inventive step (IS)	Claims	<u>1-6</u>	YES
	Claims	_____	NO
Industrial applicability (IA)	Claims	<u>1-6</u>	YES
	Claims	_____	NO

## 2. Citations and explanations (Rule 70.7)

The invention concerns a method and a tool for joining flanges or other coupling elements to pipes as stated in the preambles of claims 1 and 2.

I order to achieve a good seal and to provide a tool that is operated only radially, buckled-in areas are after-pressed outwardly as stated in claim 1 with a tool comprising radially moving segments as stated in claim 2.

The invention also concerns a coupling element for use in a tool according to claims 2, 3 and 4 as stated in claim 5.

## Cited documents:

D1: US 4154464 A  
D2: RU 2159689 (abstract)

From D1 is known a method for joining a coupling element to a pipe where circular beads are pressed into corresponding grooves in the surrounding coupling element.

From D2 from is known a method for joining a coupling element to a pipe where circular beads are pressed into corresponding grooves in the surrounding coupling element.

.../...

## Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box V

The cited documents do not disclose a method providing a first and dedicated radial directed pressing action on the inside wall of the pipe at axial locations of the pipe corresponding to location of said grooves on the surrounding coupling element to deform the pipe thereat to create said beads to project into said grooves, and providing a second and dedicated radial directed post-pressing on the inside wall of the pipe at buckled-in regions of the pipe wall that naturally occur between and adjacent the created beads during and caused by the first pressing action, to cause a post-pressing of said regions in an outward direction, thereby providing an outward tension in the pipe at the location of the coupling element as stated in claim 1.

Neither do the documents disclose a tool as stated in claim 2 or a coupling element as stated in claim 5

As the claimed method, tool and coupling element in claims 1, 2 and 5 are new, are considered to contain an inventive step, and also are industrially applicable, the patentability criteria are deemed to be met.

## Method and apparatus for cold joining flanges and coupling elements to pipes

The invention relates to a method and a tool for joining a coupling element, e.g. a joining flange means, to a pipe, said coupling element surrounding the pipe and having 5 grooves facing the pipe and intended to receive a corresponding plurality of beads provided on the pipe and a coupling element connectable to a pipe, said coupling element configured to surround the pipe and having grooves to face the pipe and to receive a corresponding plurality of beads provided on the pipe, as defined in the preamble of claims 1, 2 and 5.

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Flanges of many types and varieties are used extensively in industry when pipe-to-pipe or pipe-to-other component connections are to be provided. The welding of flanges to pipes is the most common method in the case of steel pipes and standard weldable metals, whilst, for example, screw flanges are used in connection with, for instance, 15 galvanised pipes.

In recent years a number of methods have been developed for the fastening of coupling elements and the joining of pipes by deforming the pipe inside the coupling so as to secure it. Other methods and equipment which clamp the coupling to the outside of the 20 pipe without any or with little deformation of the pipe have also been developed.

Examples of such methods are taught in US 4,593,448 and US 4,147,385. DE 27 24 257 and US 2,252,274 teach tools with rollers which by means of a rotating cone in the centre with rollers therearound will deform the pipe so that it fits into grooves in the coupling elements. DE 3144385 teaches a joining system for pipes where radially movable ridges, with the aid of hydraulic pressure against underlying pistons, press in beads. However, as discussed further below, the pipe wall on the side of the beads will buckle inwards, and when the ridges of the tool are retracted, the actual bead in the pipe will also retract somewhat, which makes the connection weak. In addition, there will be a metal-to-metal seal between pipe and coupling element, and therefore the system 25 taught in the said document will require sealing material in the grooves of the coupling element. It has been found that with radial pistons as taught in DE 3144385 it is not possible to obtain an especially large radial force, and this principle could perhaps be used with particularly thin-walled pipes.

To deform a pipe wall into grooves in a surrounding coupling element requires very large forces if the pipe wall is to be pressed radially outwards. The use of rollers as described in DE 27 24 257 and US 2,252,274 means that less radial force is required,  
5 but on the other hand the tool must be secured to the pipe and therefore becomes large and heavy. Rolling subjects the material to harsher treatment and also takes longer than radial pressing.

The object of the invention is to provide for joining flanges or other coupling elements  
10 to pipes where a tool is only operated radially so that a fixing of the pipe is not necessary. Furthermore, it is an object to obtain a tool which even in connection with small pipe dimensions has enough force to deform beads in relatively thick pipe walls. It is also an object that the tool should function so that inward tapering of the pipe end, which has been found to be a problem in connection with the radial pressing of beads, is  
15 avoided.

The new and characteristic features of the method for joining a coupling element to a pipe appear from the attached claim 1.

20 The new and characteristic features of the tool for joining a coupling element to a pipe appear from the attached claim 2, and further embodiments of the tool appear from related subclaims 3 and 4.

25 The new and characteristic features of the coupling element appear from the attached claim 5, and a further feature thereof appears from the related subclaim 6.

The invention is now to be described in further detail with reference to the attached drawing figures.

30 Fig. 1a is a side view of a pipe and a coupling.

Fig. 1b is a section A-A of fig. 1a without beads created on the pipe

Fig.1c is an enlargement of encircled region B in fig. 1b.

Fig.1d is a modified section A-A of fig.1a with beads created on the pipe

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Fig. 2a shows a modified coupling element with inserted pipe.

Fig.2b shows a section A-A of fig. 3b.

Fig. 3a shows a side view of a pipe, a coupling element and an inserted tool in a first

10 operational stage prior to coupling operation.

Fig.3b shows a section A-A through the assembly of pipe, coupling element and tool part of fig.3a.

15 Fig.3c shows a side view of the assembly shown in fig. 4a in a second operational stage of the tool after coupling has been made thereby between the pipe and the coupling element.

Fig. 3d shows a section B-B through the assembly of fig. 4c.

20

Fig. 4a is a side view of the tool, and fig. 5b is a section A-A of fig. 5a.

Fig. 5a is a perspective view of the tool from a first angle, and fig. 5b is a perspective view of the tool from a second angle.

25

Fig. 6 is a side view of the tool.

Fig. 7a is a side view of a modified tool, and fig. 7b is a functional expansion acting element of the tool.

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Fig. 8a is a side view of a pipe with a modified coupling element structure, and fig. 8b is a section A-A through the embodiment of fig. 8a.

Fig.9 illustrates final adjustment of an established coupling.

Figs. 1a – 1c show a pipe 1 and a coupling element 2 before beads 5, 6 are created.

5 Fig. 1d shows the same after the beads 5, 6 created on the pipe 1 have been pressed into recesses 3, 4, respectively in the coupling element 2.

10 Figs. 2a and 2b show a coupling element 2' fitted onto a pipe 1 and with beads 5, 6 pressed into place into recesses in the coupling element 2", the coupling element having a flange 2''' for attachment to another coupling element (not shown).

Fig. 8 shows a coupling element structure 30 with flanges 30', 30" being tiltable relative to the structure 30 by [spherical] movability over the partially spherical surface of the coupling element 30.

15 The principle of the tool is shown on Figs. 4a and 4b, whilst different applications of a cone shaped member 20, used as a mechanical force amplifier, fitted into the tool, to cause expansion of tool diameter to create beads in the pipe wall are shown in Figs. 4 - 6.

20 Fig. 7a shows a tool with a hydraulic force amplifier.

During the development of the apparatus according to the invention, which comprises both an interior configuration of the external coupling element 2; 2' and the tool 10  
25 which forms the beads 5, 6, it was quickly discovered that a most critical parameter for optimal attachment of the coupling element 2; 2' to the pipe resides in the configuration of the parts 11, 11' of the tool that presses the beads 5, 6 out from the pipe and also a part 14 of the tool that is to prevent the end of the pipe 1 from tapering inwards during the pressing operation.

30 Figs. 1a – 1d show that an outermost portion 2' of the coupling element 2 against which pipe end 1' rests is flared outwards. This is to allow the tool to give the pipe end

1' an overbending outwards, which is necessary because the pipe end, as mentioned, will otherwise tend to taper inwards. Thus, the pipe 1 will appear almost straight after the beads 5, 6 have been pressed, as can be seen in the section shown in Fig. 1d.

5 The same basic interior configuration of the coupling elements will apply to a coupling element or collar intended for loose flanges, movable flanges as shown in Fig. 8, and other types which may be suitable for a same fastening method.

10 It should be mentioned that the cylindrical part of the coupling element 2; 2" as shown on Figs. 1, 2 and 3 may advantageously be quite thin-walled. To a certain extent, the wall will then be resilient and yield a little during the pressing operation, and this will then mean that afterwards it is under inward tension and thus provides further pressure in the connection where the pipe 1 is in tension outwards.

15 Laboratory tests carried out in show that a mechanically good seal is obtained between the grooves 3, 4 and the beads 5, 6. Nevertheless, it may be appropriate to insert a sealing material in one or more of the grooves.

According to Figs. 4a and 4b, the principle of the tool is based on a plurality of segments 10, each having circle segment ridges 11 intended for being pressed out towards the inside of the pipe wall and thus forming the beads 5, 6 first. Towards the end of the pressing operation, the cylinder segment parts 13 of each of the segments forming a cylindrical assembly of segments is pressed against the inside of the pipe at the portions thereof located sideways relative to the beads 5, 6 to prevent said portions from buckling inwards. This process is shown on Figs. 3a – 3d as well as on Fig. 9. Figs. 3a and 3b show the pipe 1 and the coupling 2 before the pressing operation, and Fig. 9 is an enlarged view of an intermediate stage during the pressing where the aforementioned buckled-in areas 1" of the pipe sideways relative to the beads 5, 6 can be seen. In Figs. 3c and 3d it is seen that the cylindrical parts 13 of the segments 10 have pressed the buckled-in areas 1" back towards the coupling element 2 so that they lie almost flush with the inside wall of the pipe and its diameter. This after-pressing gives a powerful radial tensioning effect in the pipe which increases the contact pressure

between pipe 1 and coupling element 2 the sealing points between beads 5, 6 and grooves 3, 4, and prevents the retraction of the pipe 1 as mentioned above when referring to plain ridges as previously described in, for example, DE 3144385. A projection 14 is located innermost on the segments 10, i.e. close to a tool element 5 flange 21, said projection 14 intended to cause pressure against the end 1" of the pipe, as indicated also on fig. 9. In a corresponding portion of the coupling element 2 there is a recess 15 which may be made in the form of a bevel edge or a cut-out. This cut-out 15 can, for some uses, be partially filled with sealing material, or it may have an O-ring fitted therein. This special design of the tool and the coupling element has been found 10 to be necessary in order to prevent the pipe from tapering or buckling inwards as previously mentioned.

The segments 10 and especially the ridges 11 are subjected to extremely large stresses during the pressing operation and are therefore made of hardened steel. Consequently 15 large radial forces are also required to operate the segments 10. As an example thereof, the pressing of a connection between a coupling element 2 and a steel pipe 1 with an outer diameter of 76 mm and a wall thickness of 3.2 mm as shown on Figs. 1d, 2a and 2b, by using eight segments 10 would require a radial force per segment of about 200 kN, in total a required force of about 1600 kN. These are huge forces within a very 20 narrow space, and the tool according to the invention therefore uses a power actuator located outside the pipe 1 combined with a force amplifier 20 inside the pipe 1.

Fig. 5a shows the tool with segments 10 and with a circular cone 20 acting as force amplifier, Fig. 5b shows the tool with the cone 20 drawn in and the segments 10 in 25 expanded position, and Fig. 6 shows the same tool with a polygonal pyramid 20' acting as force amplifier.

Figs. 7a and 7b show a tool with hydraulically operated segments 22. A segment 22 is shown separately and it can be seen that the segment 22 is fastened to a piston 30 27 which can move in a corresponding cylinder 28 in a housing 24 which is filled with oil. The segments 22 have circle sector ridges 23 to create beads. The illustrated tool has a total of eight pistons 27 and eight cylinders 28. When a rod 25 is pressed into the

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housing, the oil in the housing 24 will press the pistons 27 outwards. The greater the diameter of the piston 27 in relation to the diameter of the rod 25, the greater the force amplification. Reference numeral 21 denotes a tool attachment flange, the flange having a plurality of attachment holes 26.

5

A cold joining of the coupling element 2 to the pipe 1 in this manner, unlike, for example, welding, that the material of the coupling is not given a modified surface structure. Therefore, the invention is suitable for couplings as shown on Figs. 8a and 8b where a coupling element 30 has an outer surface being part of a spherical surface, the coupling element 30 to be fastened to the pipe 1 and where a two-part flange has parts 30', 30" which can be joined to each other by screw action attachment, the two parts 30', 30" located on each side of the coupling element and facing one another. The flange with its flange parts 30', 30" will then be capable of being mounted at an angle which can be variably set relative to the pipe. The flange with parts 30', 30" will either be freely movable, even after screwing the flange parts 30', 30" together, or will be such that it is locked to the coupling element 30 when the flange 30', 30" is tightened to another flange (not shown).

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## P a t e n t c l a i m s

1.

A method for joining a coupling element, e.g. a joining flange means, to a pipe, said coupling element surrounding the pipe and having grooves facing the pipe and intended to receive a corresponding plurality of beads provided on the pipe, characterised in the steps of:

- providing said coupling element to surround the pipe at an end region thereof,
- providing a first and dedicated radial directed pressing action on the inside wall of the pipe at axial locations of the pipe corresponding to location of said grooves on the surrounding coupling element to deform the pipe thereat to create said beads and cause said beads to project into said grooves, and
- providing a second and dedicated radial directed post-pressing action on the inside wall of the pipe at buckled-in regions of the pipe wall that naturally occur between and adjacent the created beads during and caused by the first pressing action, to cause a post-pressing of said regions in an outward direction, thereby providing an outward tension in the pipe at the location of the coupling element.

20 2.

A tool for joining a coupling element, e.g. a joining flange means, to a pipe, said coupling element intended to surround the pipe and having grooves facing the pipe and intended to receive a corresponding plurality of beads provided on the pipe, characterised in

- 25 - that the tool has a plurality of axially separated, radially movable segments (10), each segment having a plurality of circle sector formed ridges, said plurality of segments thereby providing circumferentially extending ridges (11) capable of deforming the pipe wall by a first pressing action on the inside wall of the pipe to create on the outside of the pipe circumferential beads (5; 6) in the pipe wall and cause 30 said beads (5;6) to extend into corresponding ones of said grooves (3; 4) in the coupling element, and

- that the segments have circumferentially extending portions (13) located adjacent and between the ridges, said portions (13) in a second, subsequent pressing action to cause post-pressing of buckled-in areas that occur naturally in the pipe wall between and adjacent the beads during the first pressing action, so that an outward tension is obtained in the pipe at the location of the coupling element.

5. 3.

A tool according to claim 2, characterised in

- that a part of the segments which is to lie axially aligned with the end of the 10 pipe has a projection (14) which is configured to press the pipe end out slightly further than the diameter proper of the pipe.

4.

A tool according to claim 2 or 3, characterised in

- 15 - that the segments provide an internal conical shaped or polygonal pyramid shaped space, and
- that a cone or polygonal pyramid is locatable internally of and coaxially with the segments, said cone or pyramid when pulled towards a narrow end of said shape causing the segments to move radially outwards .

20

5.

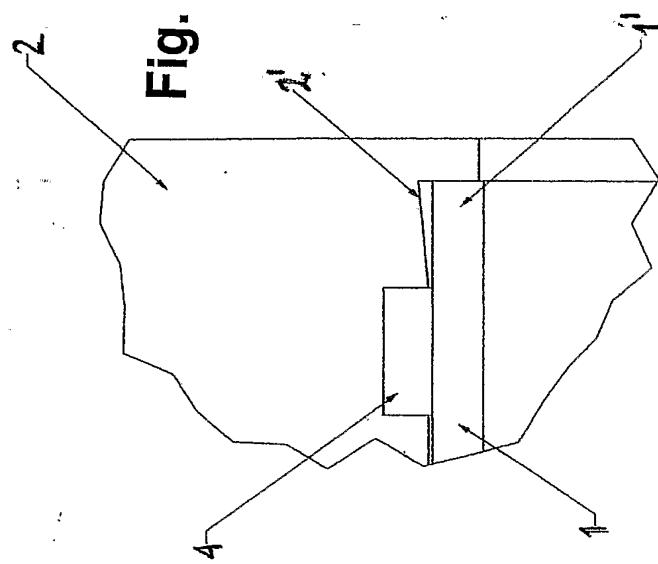
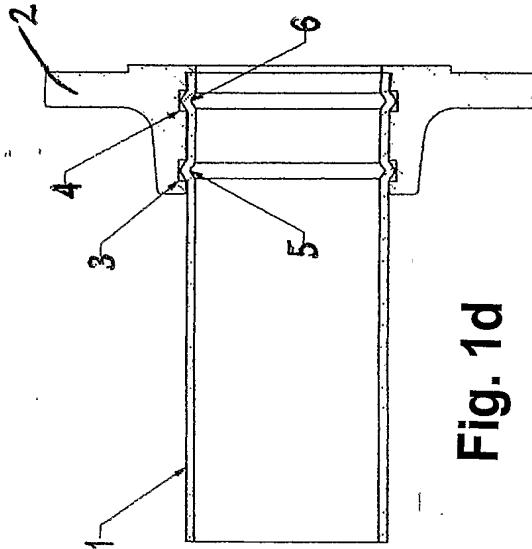
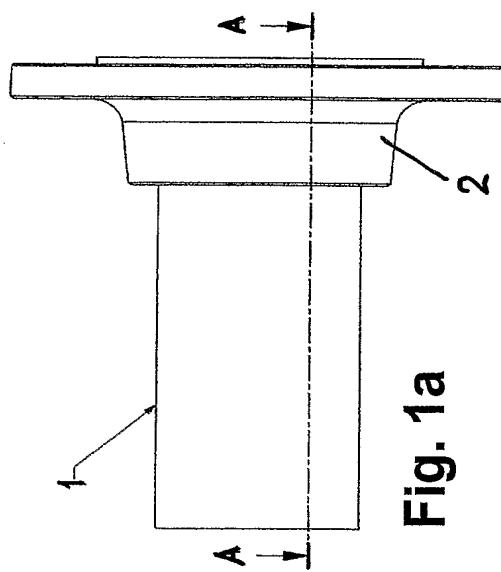
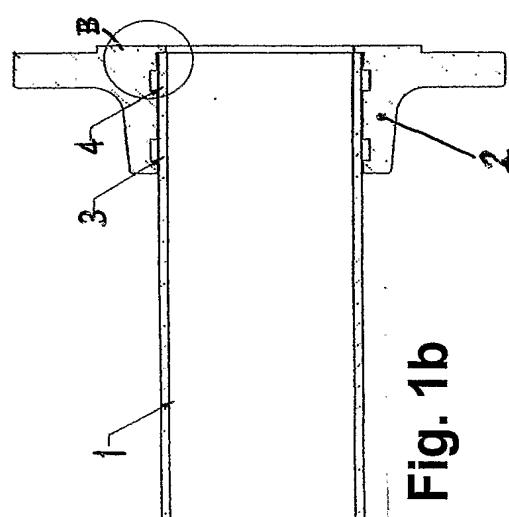
A coupling element connectable to a pipe, said coupling element configured to surround the pipe and having grooves to face the pipe and to receive a corresponding plurality of beads provided on the pipe, for use with a tool according claims 2, 3 and 25 4, characterised in

- that the coupling element at its foremost portion has a recess with a diameter greater than an outer diameter of the pipe, so that when the coupling elements surrounds the pipe and said recess is aligned with the end of the pipe, the pipe end is pressable into said recess through an outward bending action thereon

30

6.

A coupling element according to claim 5, characterised in that the coupling element (30) has a part of its outer surface spherically shaped to allow a two-part flange device with internal space thereof configured to be clamped to the surface of the coupling element, whereby a longitudinal axis through said two-part flange device is angularly adjustable relative to a longitudinal axis of the pipe.

**Fig. 1c****Fig. 1d****Fig. 1a****Fig. 1b**

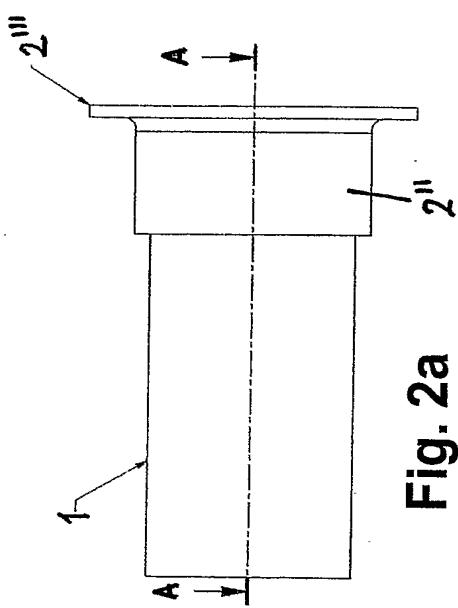


Fig. 2a

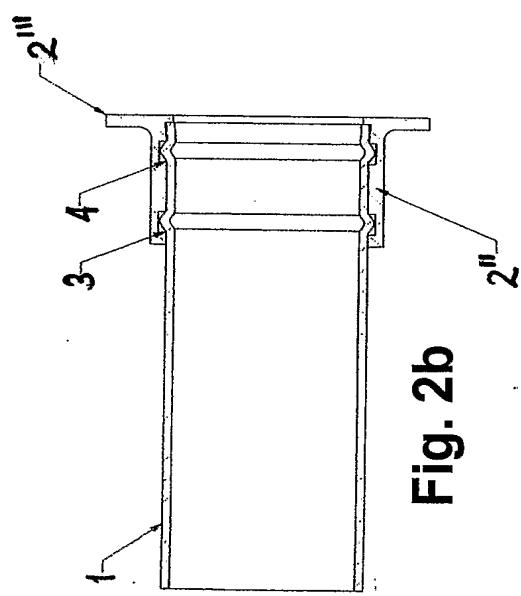


Fig. 2b

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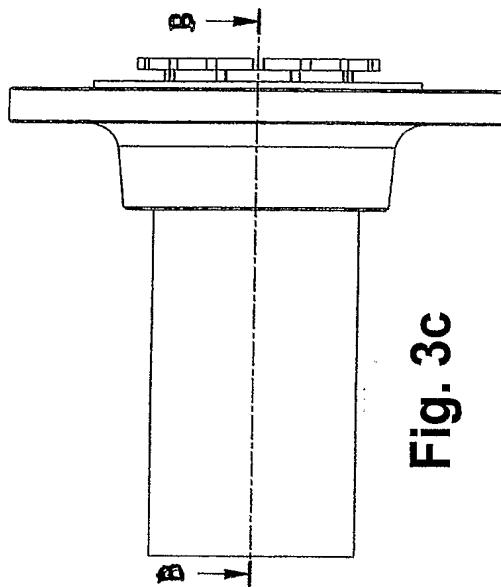


Fig. 3c

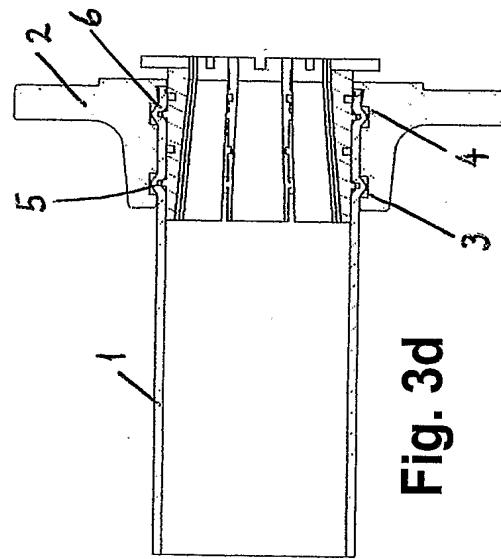


Fig. 3d

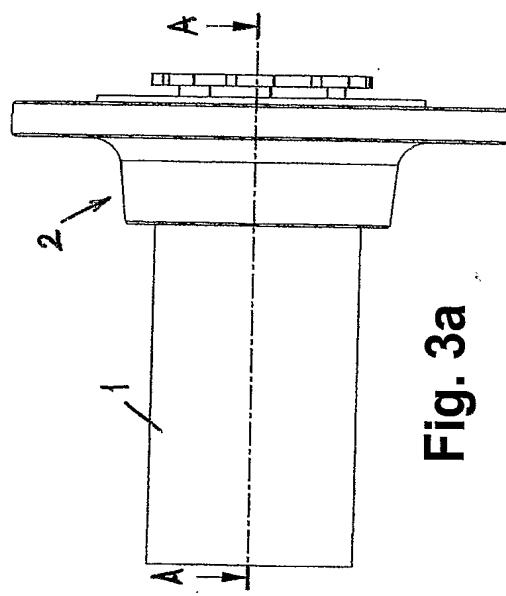


Fig. 3a

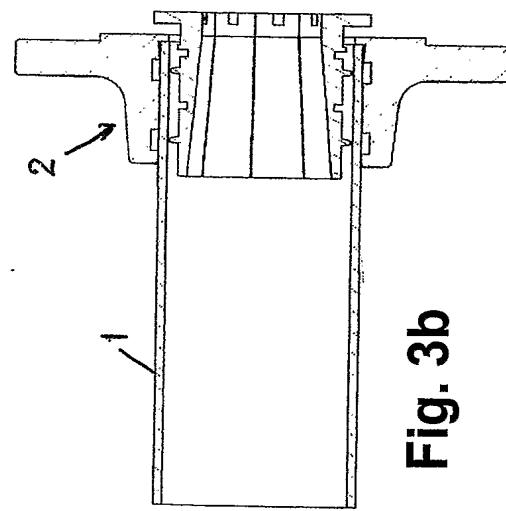
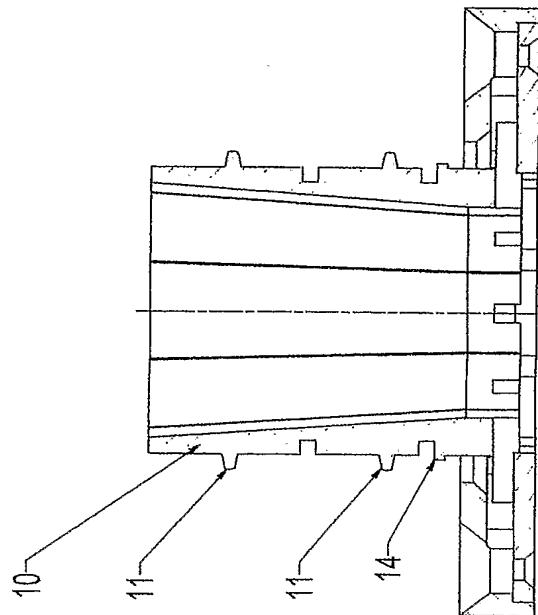
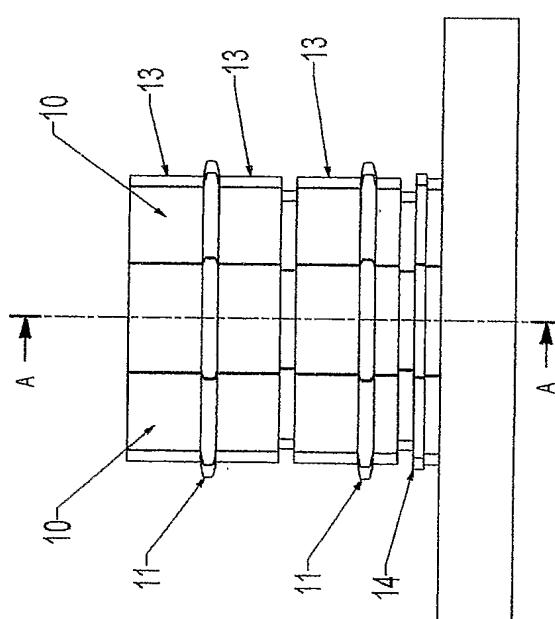


Fig. 3b

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**Fig. 4b**



**Fig. 4a**

5/10

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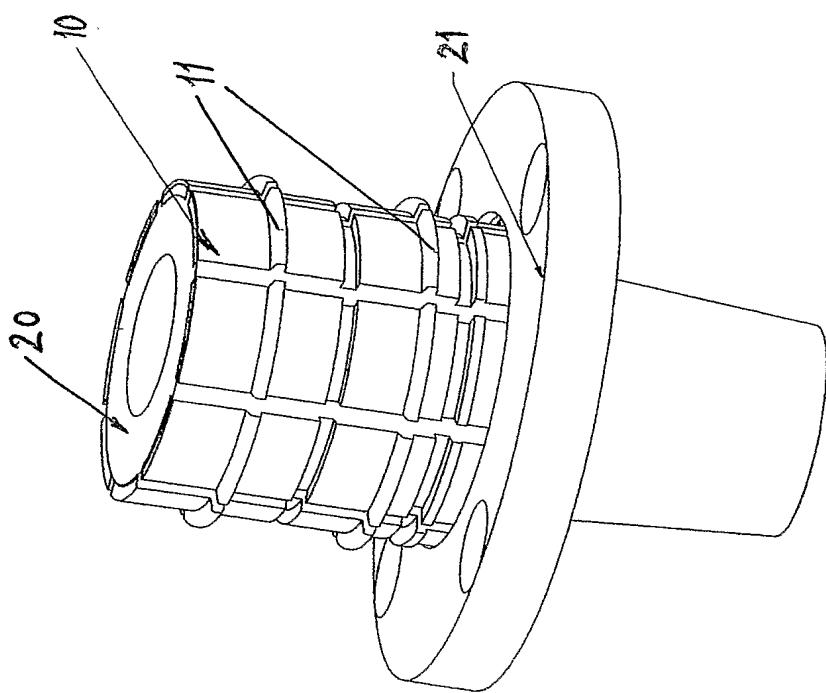


Fig. 5a

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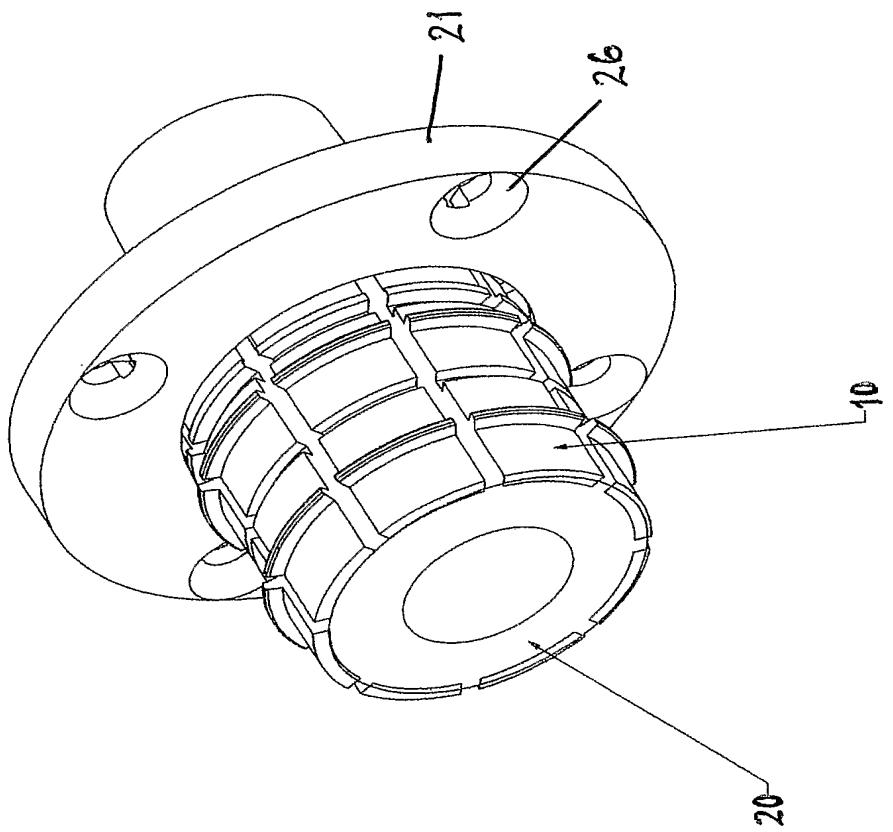


Fig. 5b

PCT/NO 2005/000093  
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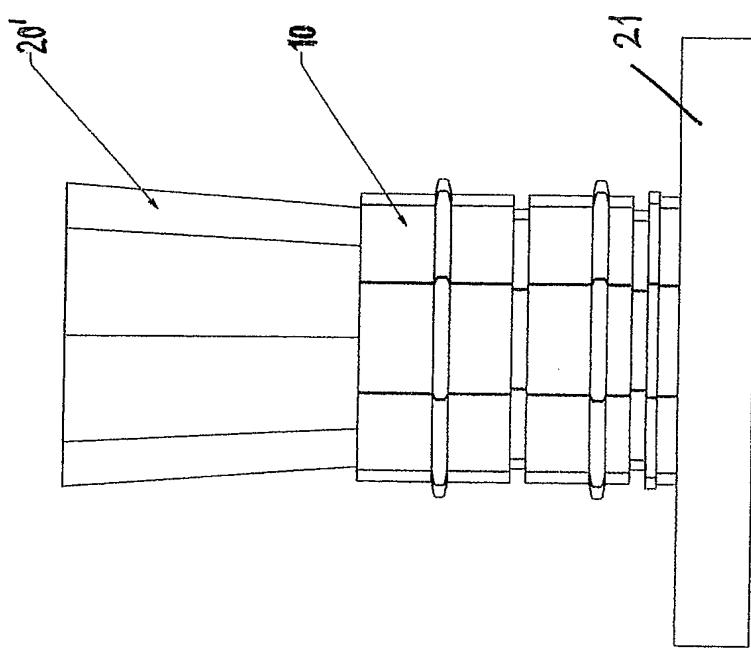
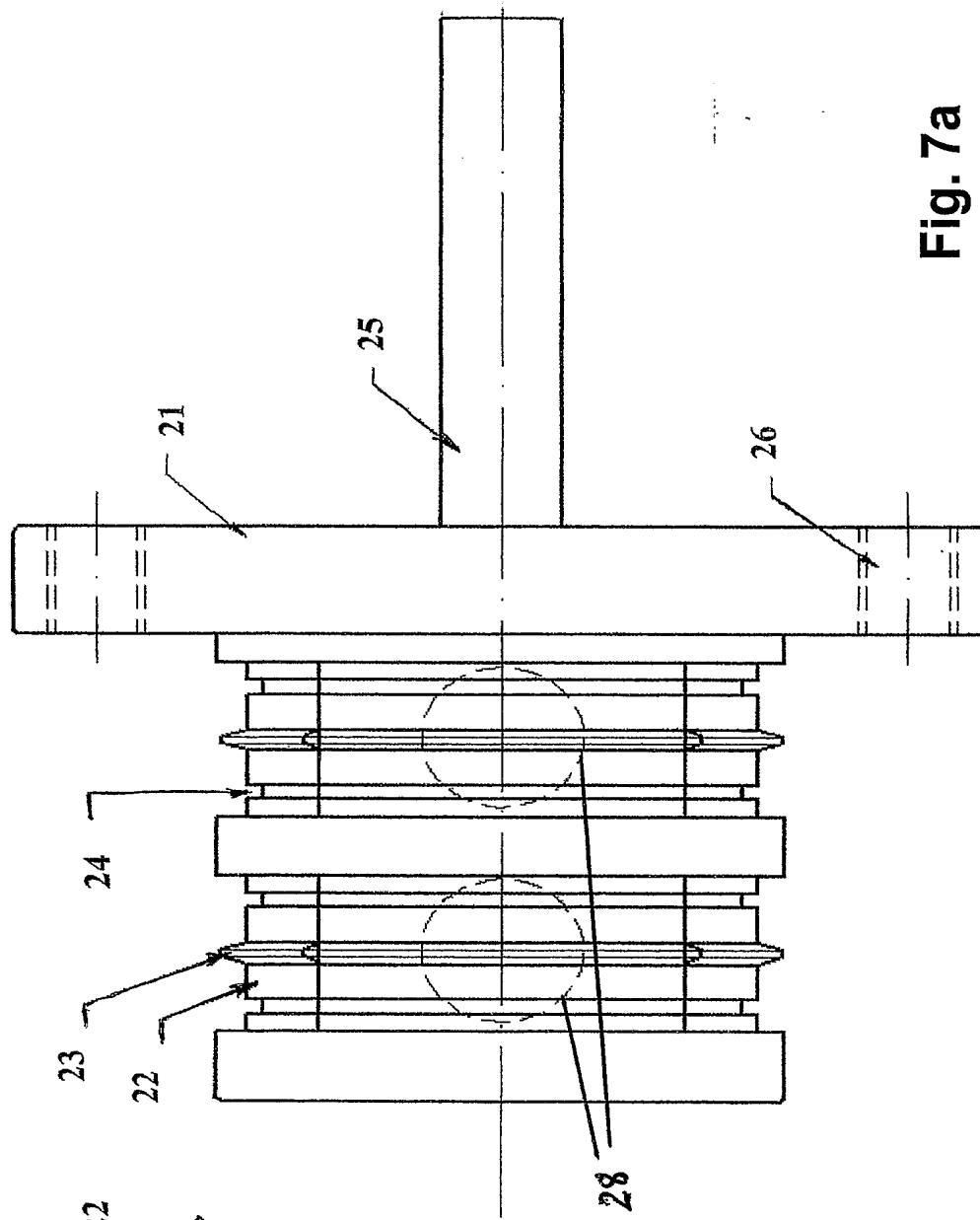


Fig. 6

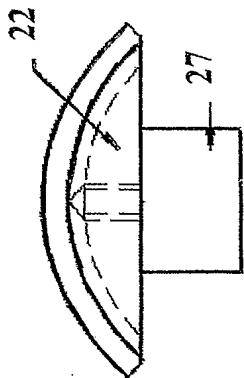
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**Fig. 7a**



**Fig. 7b**



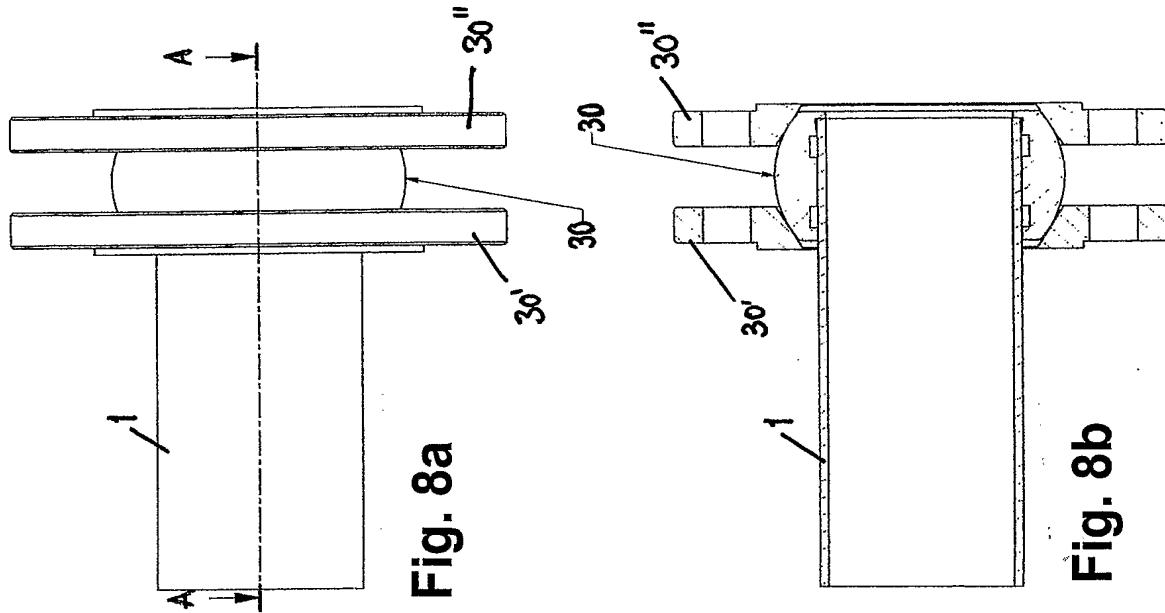


Fig. 8a

Fig. 8b

Fig. 9

